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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/414,526	10/08/1999	YEONG-KWAN KIM	SEC.637	3413

7590 12/27/2001

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EXAMINER

CLEVELAND, MICHAEL B

ART UNIT	PAPER NUMBER
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1762

DATE MAILED: 12/27/2001

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/414,526

Applicant(s)

KIM ET AL.

Examiner

Michael Cleveland

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 November 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14 is/are pending in the application.
- 4a) Of the above claim(s) 10 and 12-14 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9 and 11 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

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DETAILED ACTION

Continued Prosecution Application

1. The request filed on CPA for a Continued Prosecution Application (CPA) under 37 CFR 1.53(d) based on parent Application No. 09/414526 is acceptable and a CPA has been established. An action on the CPA follows.

Election/Restriction

2. Applicant's election of Group B in Paper No. 7 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)). The elected group reads on claims 1-9 and 11. Claims 10 and 12-14 are withdrawn from consideration.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1-9 and 11 are rejected under 35 U.S.C. 112, first paragraph, as containing ~~subject matter which~~ was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Given the confusion regarding the claim, described below, it is not clear that the applicant had possession at time of invention of the invention of uniformly

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terminating dangling bonds on the surface with a specific atom where the atom is one of plurality of "major components".

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 1-9 and 11 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "major components" is unclear because it is not defined by the specification or the prior art. For the purposes of applying art and based on applicant's arguments, the Examiner has treated the term as at least inclusive of uniformly terminating the bonds with a specific atom that is intended to be present in the final film in quantities above those of impurity levels.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

8. Claims 1, 3-6, and 8 are rejected under 35 U.S.C. 102(e) as being anticipated by Comizzoli et al. (U.S. Patent 5,851,849, hereafter '849).

'849 teaches loading a substrate into a reaction chamber (col. 6, lines 25-27);

purging with nitrogen at a temperature of 150-200 degrees C (col. 6, lines 27-28)

(Applicant states in the specification that the uniform termination is accomplished by purging the

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substrate with nitrogen at temperatures of 120-370 deg. C. Therefore, either the nitrogen purge step of Comizzoli inherently achieves such uniform termination or else the termination results from essential features which are not present in the claims.);

injecting trimethyl aluminum (TMA) as a first reactant into the chamber (col. 6, lines 29-38) (The trimethyl aluminum must inherently chemically adsorb in order to bond the aluminum to the substrate. Also, some trimethyl aluminum remains non-adsorbed (col. 6, lines 37-38).

Therefore, there must some positive pressure in the chamber, and some physisorption of the trimethyl aluminum must take place.);

purging the chamber with nitrogen to remove non-adsorbed TMA (col. 6, lines 36-41) (which removes physisorbed trimethyl aluminum); and

forming a solid thin film of aluminum oxide by injecting water vapor into the chamber to react with the TMA (col. 6, lines 38-40).

Applicant's specification reveals that the initial nitrogen purge of '849 must inherently uniformly terminate the surface with N atoms. '849 teaches that other precursor gases may be chosen to create films that contain other atoms, such as N or S (col. 7, lines 35-42) to create other films such as nitrides or sulfides.

Claim 3: A final purge inherently removes the by-products and any intermediates of the reaction (col. 6, lines 40-41).

Claim 4: The initial nitrogen purge may last several seconds to an hour. 1000 s was used as a concrete example (col. 6, lines 27-29). Such a purge may be viewed as four purges of 250 s each.

Claim 5: Applicant's specification reveals ~~that~~ the initial nitrogen purge of '849 must inherently uniformly terminate the surface with N atoms.

Claim 6: Part of the passivated surface (i.e., 41 of Fig. 5) is silicon (col. 5, lines 8-65; Fig. 5).

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Claim 9: The suggestion of the use of metal precursors with nitrogen-containing precursors to include N in the film fairly suggests the formation of metal nitride films.

Claim 8: Applicant's Table 1 reveals that inherently the bonding energy between Si and N is greater than that between Si and C (an atom from the methyl ligands of TMA).

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 1-3, 5-9, and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim et al. (Appl. Phys. Lett., 71, pp. 3604-3606, hereafter Kim) in view of Marcus et al. (U.S. Patent 5,169,579, hereafter '579).

Claims 1, 5-7, 9, and 11: Kim teaches loading a silicon substrate into a reaction chamber, cleaning to uniformly terminate the surface with atomic hydrogen, dosing with TMA, which inherently chemisorbs to the surface, purging with TMA, which inherently removes any physisorbed TMA, and injecting water to react with the TMA to form an alumina film (p. 3604).

Kim does not teach uniformly terminating the surface bonds with atoms intended as major components of the film (e.g., oxygen).

'579 teaches that a surface may be prepared for subsequent film growth (See col. 3, lines 39-68) by modifying the surface to terminate in bonds to either hydrogen or oxygen (col. 7, lines 23-39). Therefore, it would have been obvious to one of ordinary skill in the art at the time the

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invention was made to have initially uniformly terminated the surface of the silicon substrate of Kim with oxygen instead of hydrogen with the expectation of similar results.

Claim 2: Kim teaches that the substrate may be cleaned of a native oxide before being loaded into the chamber, but does not explicitly state that the cleaning step comes before loading the substrate into the chamber. However, it appears that it would have been obvious to one of ordinary skill in the art at the time the invention was made to have provided the cleaning step before loading the substrate into the ALD chamber in order to avoid damage to and contaminants in the ALD chamber by the HF used in the cleaning process.

Claim 3: A final purge inherently removes the by-products and any intermediates of the reaction (p. 3604, col. 2).

Claim 8: Applicant's Table 1 reveals that inherently the bonding energy between Si and O is greater than that between Si and C (an atom from the methyl ligands of TMA).

11. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of '579 as applied to claim 1 above, and further in view of Gray (U.S. Patent 5,350,480, hereafter '480).

Kim and '579 suggest the formation of an oxygen-terminated silicon surface before the formation of an oxide film by ALE, but do not specify the method of achieving the oxygen termination.

'480 teaches that silicon surfaces may be uniformly terminated with oxygen by treatment with O₂ (col. 16, lines 30-col. 17, line 2). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have achieved the oxygen termination suggested by Kim and '579 by treatment with oxygen with a reasonable expectation of success. Such treatment would necessarily occur for a finite period of time, and that period of time could be viewed as subdivided into a plurality of consecutive stretches of time (and therefore a plurality of consecutive treatments).

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Response to Arguments

12. Applicant's arguments filed 8/27/01 have been fully considered but they are not persuasive.

Applicant argues that the claims are patentable because of the new limitation which requires that the terminating atom be a major component of the film. The new limitation results in the withdrawing of the rejections under 35 USC 102(e) of claims 7 and 11 over '849. However, Applicant provides no explanation why the amendment overcomes the following embodiments suggested by the prior art and pointed out in the Final Rejection mailed 2/26/01 (Paper No. 10):

1) Comizzoli teaches such for at least nitrogen for the reasons given in the prior action and because Comizzoli teaches that nitride films may be formed in place of the alumina film via epitaxial methods (col. 7, lines 35-42). 2) Marcus et al. teaches the equivalence of hydrogen-terminated and oxygen-terminated substrates for film growth. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have uniformly terminated the substrate bonds of Kim with oxygen instead of hydrogen with the expectation of similar results.

Conclusion

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael Cleveland whose telephone number is (703)308-2331. The examiner can normally be reached on Monday-Friday from 8:30 a.m. to 4:00 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck, can be reached at (703) 308-2333.

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A handwritten signature in black ink, appearing to read "Michael Cleveland".

Michael Cleveland

December 21, 2001

A handwritten signature in black ink, appearing to read "Brian K. Talbot".

BRIAN K. TALBOT
PRIMARY EXAMINER